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crop from the soil, to avoid loss from destructive agencies, or to double the capacity of human labor if the gain is all absorbed by an aggressive few and the scientist and the real producer are left with no betterment of condition.

Such absorption does too often occur and it is not much to be wondered at that the pessimistically inclined should question what profit there is in our boasted scientific progress if the advantages of it all are to be seized upon and appropriated by an inner circle who can. One of the most important problems of the age is to discover how the gains of scientific discovery may be equitably shared by all deserving members of society.

But such an occasion impels us to look forward as well as backward. What will the next quarter century of science reveal to us of the unknown, what problems of age-long study will have yielded their solution, what theories of to-day will have vanished and what will be the nature of those to take their place. For this we can simply say wait and see; we may be content to believe that progress must continue and I believe we may also say that in most lines this progress will be on the foundations already laid. For one, I have sufficient faith in the science of to-day to believe that we have reached a secure footing and that we may push forward with confidence that the structure we build will not be doomed to complete destruction, even if in some of its details the lines must be recast. At least one strong ground for effort is confidence in the truth and permanence of the structure on which we work and despite occasional voicings of dissent I would hold for faith in our own work.

When the next quarter century shall have passed and you celebrate another anniversary, as I have no doubt you will, for the academy is now so fully established

that its lapse is unthinkable, you will plan a wider home-coming to include the many members who will have scattered farther still to the ends of the earth and I shall hope to meet many or all of you now here with many yet to come in that semicentenary of our birth. Mr. President, you need not for that occasion send me any invitation. I shall come without one if alive, as I hope to be, and if it is within the range of human possibility to do so. But whether here in flesh or not, I assure you I shall be in thought and spirit, for I shall carry with me from this day on not only my early love and devotion for the academy, but an abiding appreciation for the honor you have shown me in asking me to be present with you and for the cordial greetings from you all. For all this and for your kind indulgence in listening to these remarks, I most sincerely thank you.

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ECONOMY IN UNIVERSITY ADMINISTRATION

I PROPOSE to consider briefly what I believe to be the most important factor in university economy, namely, the selection of the work which the university shall undertake.

Every important development depends upon two conditions: first, an adequate stock of energy; second, the selection of a few out of many possible channels through which that energy may produce its best results. A man will grow apples. His first concern is to secure a maximum amount of apple-producing energy in the form of well-bred stock, good soil, appropriate fertilizers, *et cetera*. His second concern is to save that energy from being wasted through weeds, through too many trees per acre, too many limbs upon the trees, or too many apples upon the limbs. His chief

labor is to destroy alien growths, cut down redundant trees, cut off redundant limbs, and cull out redundant apples, so that the total apple-producing energy at his command may through a few channels produce the largest possible crop of the best possible apples. Wherever any first-rate result is to be secured, there must be these two conditions—adequate wealth of resources, but also severe selection. “To know how to omit,” says Stevenson, “that is the whole of art.”

The universities of the United States, taken as a whole, have had decided success within the past quarter century in meeting the first of these two conditions of development. The resources of the universities still fall far below the demands which our society makes upon them for service; but the absolute increase in university funds from private and public sources within that time has been very great. It is the belief of the writer that the universities have not been equally successful in meeting the second condition of development, and that the paramount need in our university administration is a severe selection of the channels through which our resources shall be expended.

The pressure toward expansion, toward the multiplication of colleges, schools, departments, subdepartments and individual courses, is constant. All those who help determine what the university shall undertake, trustees, president, heads of departments and individual members of the faculty, feel this pressure. Part of the pressure is meretricious, proceeding from unworthy rivalry between universities, or from unworthy rivalry between departments, or from other motives comparable to those which appear in the lower forms of commercial competition. Part of the pressure toward expansion is fundamental, proceeding from the deep social needs

which have given rise to the university itself. There had to be an enormous expansion of the university's activities in comparison with what they were in 1875. The university exists to solve the problems which our complicated civilization must solve, and to train up men able to take the varied and difficult kinds of work required by that civilization. The so-called university of 1875 fell far short of doing either of these necessary things. The universities, taken together, must do both these things, must represent the whole of civilization as it is, and must attack every problem around the whole sphere of possible discoveries.

In order to do this, it was necessary, for one thing, that the universities should supplement the liberal arts college as it was in 1875 by the addition of new departments, schools and colleges, and for another, that each of the fundamental departments should undergo a corresponding expansion. A university department of chemistry, for example, does not exist in order to teach a little primary chemistry to sophomores. It exists to make the great underlying science of chemistry render the fullest possible service to mankind. A university department of chemistry, if properly supported and manned, tends to become a college in itself, with a budget and faculty comparable to that of the entire institution of forty years ago; and, in the best cases, everything done in the department is worth more to society than it costs. In many cases, the people have realized this quickly, and have met daring expansions made by the universities with means adequate for their support. In some cases, we have a university whose circle of activities approaches correspondence with the whole circle of services which society requires from learned men.

Unhappily, however, there is no univer-

sity rich enough to carry out with success so vast a program. In truth, all the universities in the world are not now rich enough to do so. The richest university is, therefore, in peril of so multiplying the lines of its work that all the lines of its work shall be lowered in quality. It is very possible in this way for a university with a million or more of income to so scatter its resources that it can do nothing at all of first-rate quality. Whether a university be relatively rich or poor, its greatest mistake, financial and educational, is to indulge in a policy of expansions which fail to elicit their own support and which must, therefore, live by sapping the strength from established lines of work. This mistake may be made by the regents and the president in establishing new departments, schools or colleges, or by heads of departments in establishing new subdepartments or new sporadic courses, or by individual members of the faculty in undertaking indiscriminately wide lines of research. All these different forms of expansion come to the same thing if they involve spending money upon more things than can be done well.

The penalties which fall upon an institution which sins greatly in this respect are severe. The library suffers. The laboratories suffer. Salaries are kept down. The best men escape. Those who remain lose heart. The quality of everything done about the institution is lowered. The final calamity is that all this tends to bring to and establish in the institution a faculty of mediocre men. There is no known remedy for this calamity. If the institution grows suddenly rich, the way to progress is blocked by a group of men who can not be removed except by death, and whose mediocrity will pervade the institution for a generation. It is my belief that there is no American university which has not suffered

more or less by expansions which have affected the quality of its work. It is certain that some of the universities with small incomes, in their effort to cover every field, have brought themselves in every field to a deplorable weakness. And it is certain that some among the universities with large incomes have, through the same error, grown large without having grown great.

By way of remedy, I venture to make four suggestions, two of which I have discussed at greater length in a former paper.

1. Heads of departments should, I believe, resist the constant temptation to multiply courses of elementary collegiate grade in order, as the phrase is, to cover the ground represented by the department. Instead of this policy, which tends toward waste and lowered efficiency, there should be severe selection of a narrow program of freshman-sophomore courses which shall represent typically the best things in that field. I believe that this second policy, carried out with intelligence by men who believe in it, means, for one thing, a radical economy in university resources, and, for another, greatly improved work. Even if there were no question of finance involved, the greatest pedagogical need in our colleges, as in all our schools, is the selection of a few essentials, so that students may master something intensively, and acquire the habit of mastery.

2. Heads of departments should resist the constant temptation to allow the multiplication of redundant junior-senior electives. Whenever a new elective of this grade is proposed, it should be confronted with two questions: (1) Is this course an essential part of the department's undergraduate program? (2) Is the course an essential part of a program of research which the department is prepared to undertake? If it serves neither of these two interests, it is the enemy of both. It should

be seen by all concerned that the sporadic elective is the greatest obstacle in the way of raising the salary of the man who gives it, as well as that of all his colleagues. For the per capita cost of such a course is nearly always very high, and can come from nowhere except the total available salary fund. The university must maintain many small classes in its advanced work. A class of one may fully justify itself to the university world and to the state which pays for it. But it is the interest, as well as the duty, of all concerned to see that every small class shall so justify itself.

3. Members of the graduate faculty should resist the temptation to provide equipment for research over wide ranges of their subjects. Instead of this, the professor who conducts research should plan a program of studies within which he and his students for a period of years shall work, and upon which his appropriations for graduate work shall be concentrated. No hard and fast line of definition can be drawn between these two policies. The broad difference between them is clear. Only the richest of our universities can do anything of quality in the way of research if the first policy is followed, and even in those cases there must be a great and unnecessary waste. On the other hand, any one of a score or more of our universities can successfully carry out the second policy. Let me give two out of many possible illustrative cases. Ten years ago a young scholar found himself in a university whose library was wholly inadequate for his studies. In presence of this situation he selected with deliberate care a program which he thought the university would be able to support. The trustees met his plan with warm approval. The total amount appropriated in the ten years was not great, but it proved sufficient for the purpose, for it enabled the man to write the best book

within his special field, and incidentally it enabled him to accumulate the best working library for that field in the country, with two exceptions. The other case presents still more striking proof of the effectiveness of this policy, chiefly because it has been carried on for a longer time. In this case the man began twenty years ago. Within that time he and his advanced students have worked along the lines of two programs. He has had many graduate students, including a considerable number who have taken the doctor's degree under his direction. In both the special fields referred to he is recognized as the first authority in the world. He has accumulated for his work, so he states to me, the best library in the world. Yet the entire cost of this special library and of his laboratory equipment would be well within the means of any standard university in the country. If the same man had been led astray in the outset into browsing about over his interesting field, the whole of his splendid achievements would have been impossible.

Before I leave the subject of research, I wish to say that it is a great waste of resources to force the entire faculty into this form of work. Let each man do what he cares most for and can do best. If a man can write good prose or good poetry, or can train any of his students to do so, let us preserve that man and his work as precious, and not spoil all with the demand for orthodox doctors' theses. If a man finds out how to train freshmen in English composition, or how to develop a finer practise of honor among college men, let us count these achievements worth as much as if he had written a thesis upon what some one did with the same problems in England a hundred years ago.

4. The regents or trustees should be on guard against the constant temptation to multiply departments, schools and colleges

which are not justified. It is obvious, as I have already said, that the regents cannot follow any set rule of thumb in this their most important sphere of decisions. They may upon occasion err disastrously in either direction. What we hope from the regents is that they shall at all times stand resolutely for the maintenance of *quality*, and that they shall refuse to permit any student-catching or appropriation-catching expansion which can not justify itself in terms of fundamental social service. If the regents go astray at this point, whether through bad counsel or from their own initiative, nothing can save the university under their control from grave deterioration.

This paper should not conclude without reference to that university which in its early history went to the extreme in the concentration of its resources. I refer, of course, to Clark University. The trustees of that institution believed that they were not justified in founding one more New England college. They had not enough money to found a university where the usual round of departments should be adequately represented. Under the advice of G. Stanley Hall, they resolved upon the unprecedented plan of beginning a university with five departments. The result of this course was that in each one of those departments they secured a group of scholars unsurpassed in the country, if anywhere in the world. They had Whitman, Loeb, Michelson, Nef, Boas, Mall, Story, Bolza, Donaldson, and many other men who then had, or since have, won international standing. They had the only American scholar who has won the Nobel prize. The group of scholars at Clark and the work done there were at once recognized by the university world as of first-rate importance. A change of mind on the part of the founder and other conditions have

modified the later history of Clark. Its example is one which no other university, certainly no state university, can follow in the extreme. But the history of Clark proves one thing of the utmost importance—that a university of relatively limited means may go into the front rank by sagacious concentration of its resources.

The members of this association realize well the difficulty of securing money for the university. But, in truth, it is not so difficult to get money as it is to spend it so as to have a minimum of waste and a maximum of efficiency. Our task is to discover and create the university for our century. The discovery demands statesmanlike discrimination between what is essential and what should be pruned away. The creation demands something still more difficult, for it demands a thousand decisions which cut across private interests. The institution which we actually create will depend upon the self-denial, the integrity and the courage with which members of the university day by day make these decisions.

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LECTURES ON THE SMOKE PROBLEM

In the fall of 1911 the Department of Industrial Research of the University of Pittsburgh was provided by a Pittsburgh business man with funds for a thorough investigation of the smoke nuisance. At the present time the investigation is being conducted by a staff of twenty-five specialists, of whom seven are giving their entire attention to this task. Some of these men are studying the effect of smoke and soot on the atmosphere, on the weather, on plant life, on buildings, on the public health; some are investigating the economic damage done by smoke and soot; others are making a detailed study of the mechanical devices for preventing or abating smoke; and still others are inquiring into the chemistry and physics of smoke and soot, into the laws